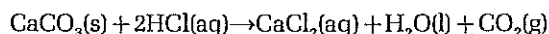


8.7 Particle size and reaction rate

Calcium carbonate occurs naturally in several forms, for example, as limestone, marble, chalk and calcite. All of these react with dilute hydrochloric acid to give calcium chloride, water and carbon dioxide.



The rate of this reaction can be investigated by adding marble chips to dilute hydrochloric acid in a conical flask. The total mass of flask and contents decreases as the carbon dioxide escapes. This loss of mass can be followed by placing the flask on a top-pan balance.

Aim

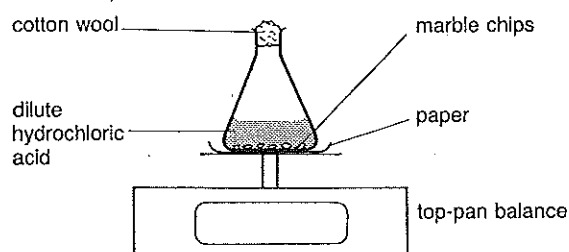
To investigate the effect of marble chip size on the rate of production of carbon dioxide for the reaction between marble chips and dilute hydrochloric acid.

Apparatus and materials

Three conical flasks, 100 cm³
 Stopclock or timer
 Measuring cylinder, 100 cm³
 Top pan balance reading to 0.01 g
 Paper for weighing
 Cotton wool
 Graph paper
 Dilute hydrochloric acid, 2 mol dm⁻³
 Marble chips; large, medium and small

Procedure

- 1 Use the measuring cylinder to pour 40 cm³ of dilute hydrochloric acid into the conical flask.
- 2 Place a loose plug of cotton wool into the neck of the conical flask.
- 3 Weigh out 20 g of small marble chips.
- 4 Place the flask and the marble chips on the balance pan. Record the total mass of flask plus acid plus chips plus cotton wool.
- 5 Add the marble chips to the acid and replace the cotton wool plug. Start the timer.



- 6 Record the mass of the flask and its contents every half minute until there is no change.
- 7 Plot a graph of loss in mass, in grammes, against time in minutes.
- 8 Repeat steps 1–7 for medium and then large marble chips.

Results

Copy and complete three separate tables, one for each size of marble chip:

Size of marble chips

time/min	mass of flask + contents/g	mass of carbon dioxide produced/g
0		
$\frac{1}{2}$		
1		
$1\frac{1}{2}$		
2		
$2\frac{1}{2}$		
3		
$3\frac{1}{2}$		
4		
$4\frac{1}{2}$		
5		

Questions

- 1
 - a) Why is the ceramic wool plug used?
 - b) Which marble chips have the greatest surface area?
 - c) Why do the graphs eventually become horizontal?
 - d) Why does the mass of the flask and its contents decrease?
 - e) Name the substances left in the flask when the experiment has finished.
- 2 Devise an investigation based on the experimental method above to find out if various metal oxides catalyse the decomposition of hydrogen peroxide.